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By (4),

$$\int_0^a \frac{x^{a-1}}{1+x}\,dx = \frac{\pi}{\sin \pi a}.$$

$$\int_0^a \frac{e^{-y}}{y^a}\,dy = \int_0^a y^{-a}e^{-y}dy = \int_0^a y^{(1-a)-1}e^{-y}dy = \Gamma(1-a).$$

$$\therefore \quad \Gamma(a)\Gamma(1-a) = \frac{\pi}{\sin \pi a},$$

and

$$\Gamma(1+a)\Gamma(1-a) = \frac{\pi a}{\sin \pi a}.$$

Also solved by T. M. BLAKSLEE, C. N. SCHMALL, A. M. HARDING, A. L. MCCARTY, and J. W. CLAWSON.

355. Proposed by C. N. SCHMALL, New York City.

Given the curve of the nth degree,

$$y^n - (a + bx)y^{n-1} + (c + dx + ex^2)y^{n-2} + \cdots = 0,$$

show that if each ordinate is divided by the corresponding subtangent, the sum of all the resulting ratios will be a constant.

SOLUTION BY J. W. CLAWSON, Collegeville, Pa.

The question should read: "show that if for a given abscissa each ordinate . . . ."

The sum of all the ordinates corresponding to a given abscissa x_1 is equal to minus the coefficient of y^{n-1}, viz., $+ (a + bx_1)$.

Hence, the sum of the derivatives of the several ordinates will be $+ b$.

But each subtangent is the ordinate divided by the slope of the curve at the top of the ordinate. Hence any ordinate divided by its corresponding subtangent is equal to the slope of the curve at the top of that ordinate. We have just shown that the sum of these slopes for all the ordinates corresponding to a given abscissa is a constant. This proves the problem, as amended. See EDWARDS' *Differential Calculus*, page 151.

Also solved by the PROPOSER.

MECHANICS.

274. Proposed by G. B. M. ZERR.

A sphere moves on the concave side of a rough cylindrical surface of which the transverse section perpendicular to the generating lines is a hypocycloid. If $s = l \sin n\theta$ be the intrinsic equation of the hypocycloid, then $l = (a - b)4b/a$, $n = a/(a - 2b)$, where a = radius of fixed circle, b = radius of rolling circle.

REMARK BY A. H. WILSON, Haverford College.

The statement of this problem is incomplete. As it stands it is not a problem at all.

275. Proposed by W. J. GREENSTREET, Editor of the Mathematical Gazette, England.

If a particle be attracted towards the angular points of a regular hexagon by forces equal to r^{-h}, at distance r, find the condition for stability of equilibrium.

SOLUTION BY A. H. WILSON, Haverford College.

The discussion is for the center of the hexagon, an obvious position of equilibrium. Let this point be taken as origin, the hexagon placed with two vertices on the x-axis. Let r_0 be the side of the hexagon.

Form the potential function V. For one attracting center this is of the form $\int_{r_0}^{r} r^{-h}dV = r^{1-h}/(1-h) - r_0^{1-h}/(1-h)$. (The value $h = 1$ must be excepted.) For simplicity the origin is taken as a standard position.

$$V = \Sigma r^{1-h}/(1-h) - V_0.$$

Each r is of the form $[(x-s)^2 + (y-t)^2]^{1/2}$. Expand V in the neighborhood of the origin in powers of x and y. For r^{1-h} this expansion is

$$r^{1-h} = r_0^{1-h} + s(1-h)r_0^{-h-1}x + t(1-h)r_0^{-h-1}y + \tfrac{1}{2}[(1-h)r_0^{-h-1} - (1-h^2)s^2r_0^{-h-3}]x^2$$
$$-(1-h^2)r_0^{-h-3}st\cdot xy + \tfrac{1}{2}[(1-h)r_0^{-h-1} - (1-h^2)r_0^{-h-3}t^2]y^2 + \cdots.$$

For (s, t) substitute successively the coördinates of the hexagon points and sum:

$$V = V_0 - \tfrac{1}{2}(2+3h)r_0^{-h-1}(x^2+y^2) + \cdots.$$

In the neighborhood of the origin then the equations of motion are

$$m\frac{d^2x}{dt^2} = -\frac{\partial V}{\partial x} = (2+3h)r_0^{-h-1}x,$$

$$m\frac{d^2y}{dt^2} = -\frac{\partial V}{\partial y} = (2+3h)r_0^{-h-1}y.$$

For stable equilibrium we must have here

$$2 + 3h < 0.$$

MISCELLANEOUS QUESTIONS.

EDITED BY R. D. CARMICHAEL.

NEW QUESTIONS.

19. How many known proofs are there of the proposition that the square of the hypotenuse of a right-angled triangle is equal to the sum of the squares of the other two sides? Where are the proofs to be found?

20. Some of our readers would like to have a simple account, without proofs, of just what has been accomplished toward the proof of the theorem that the equation $x^n + y^n = z^n$ is impossible in integers when $n > 2$.

21. For the diophantine equation

$$x^2 - y^3 = 17$$